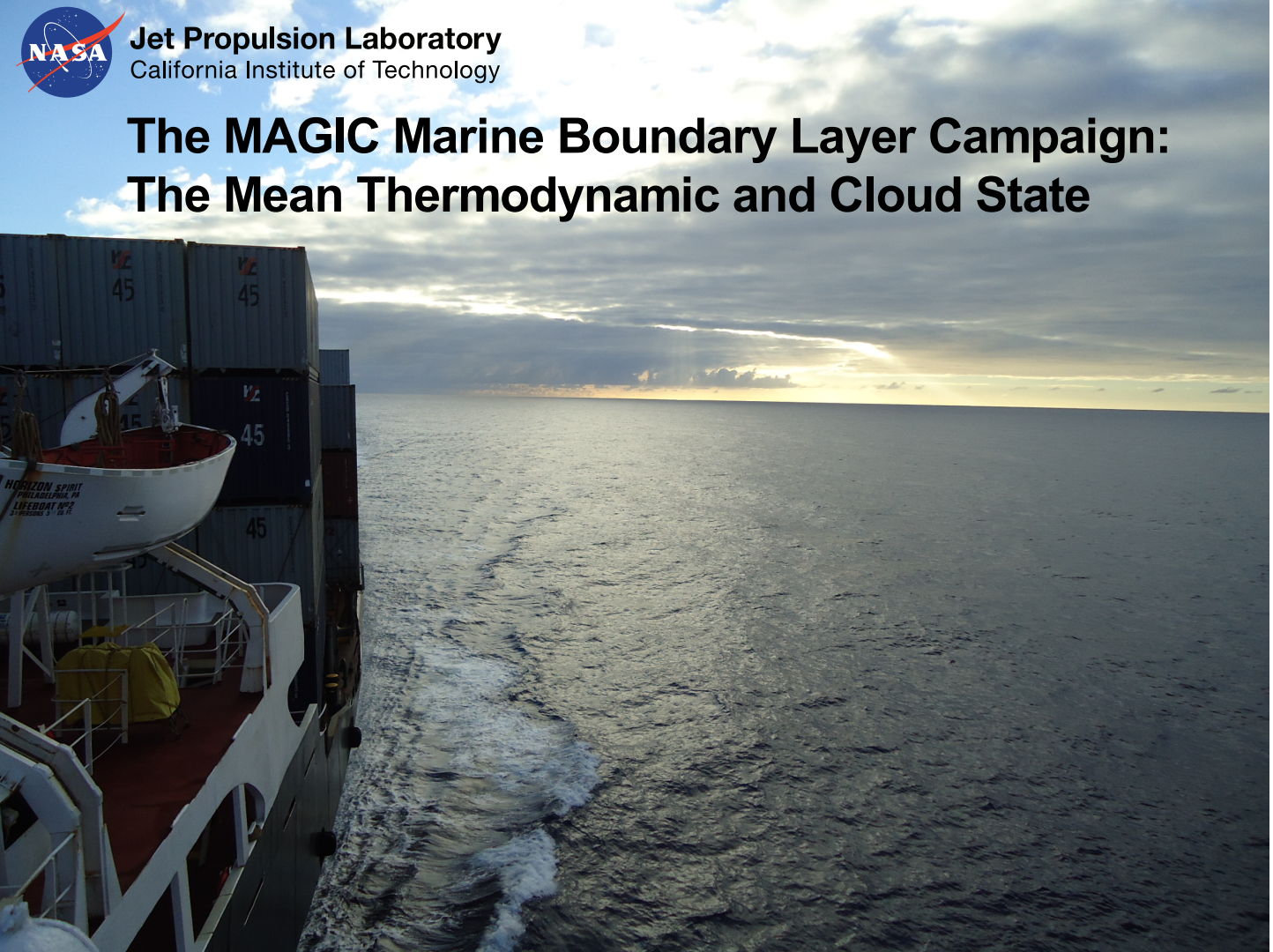

Jet Propulsion Laboratory
California Institute of Technology

The MAGIC Marine Boundary Layer Campaign: The Mean Thermodynamic and Cloud State

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Joao Teixeira[1]
Ernie Lewis[2]
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[3]Remote Measurements and Research Co.

MAGIC
Marine ARM GPCI Investigation of Clouds

ARM mobile facility installed on a container ship

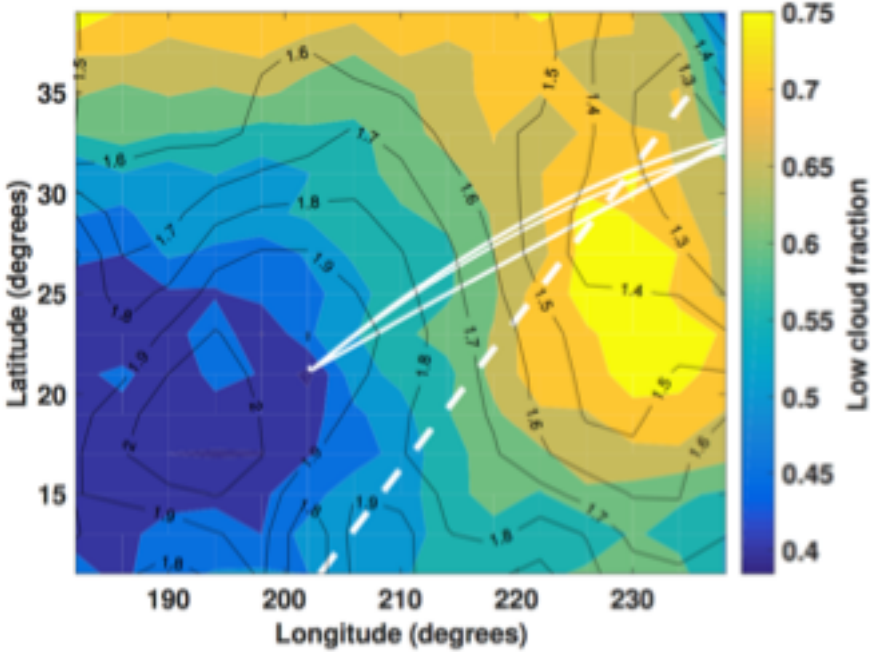
19 round trips trips between LA and Honolulu, 9/2012 – 10/2013

550 successful radiosondes in the analysis

The MAGIC Campaign

Samples transition between stratocumulus (SC) and trade cumulus (CU) cloud regimes

Nearest practical approximation to the GPCI transect (dashed white line)



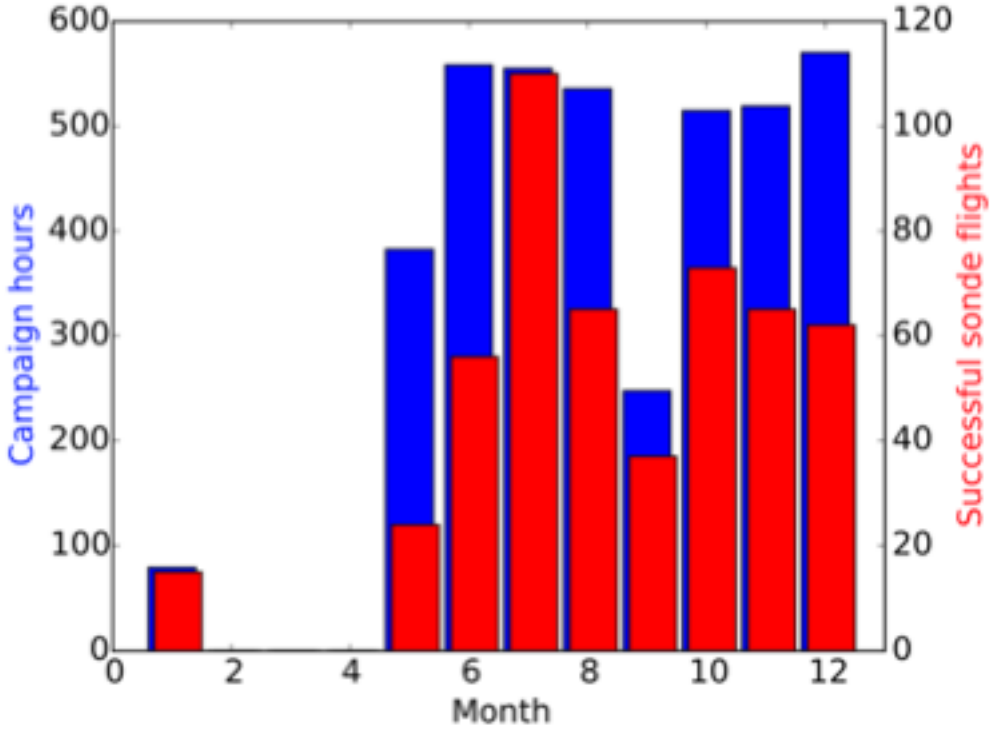
CloudSat/CALIPSO fractional cloud cover up to 680hPa (colored contours) and COSMIC boundary layer height (black contours, km). 2007-2010 JJA means.

The MAGIC Campaign

3962 hours of campaign data

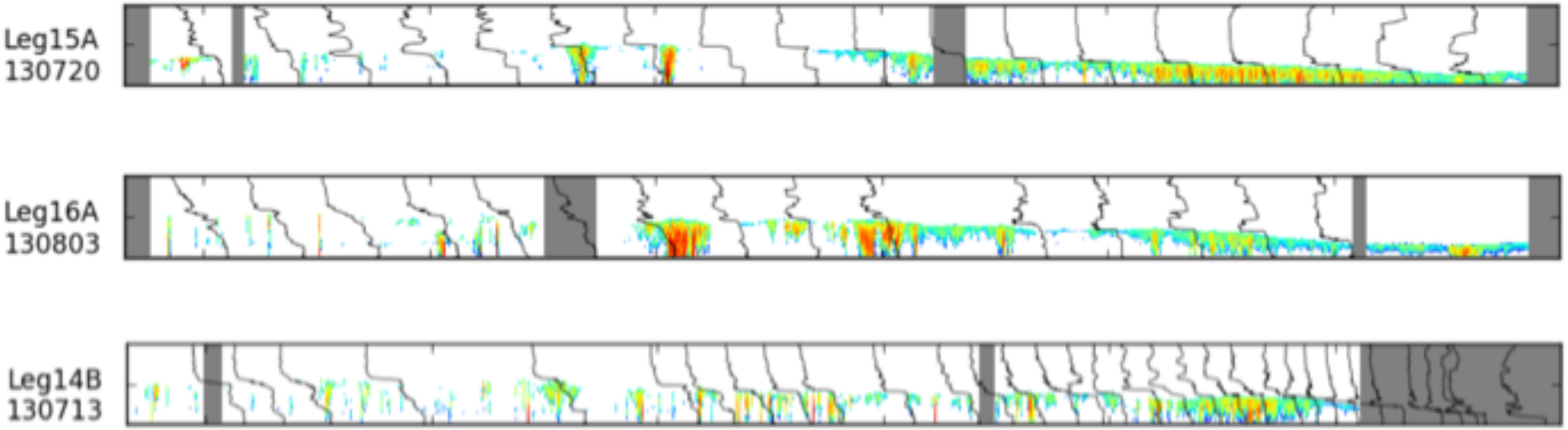
Seasonal bias in data collection:

Horizon Spirit underwent a bridge retrofit in China from 1/13 to 4/13

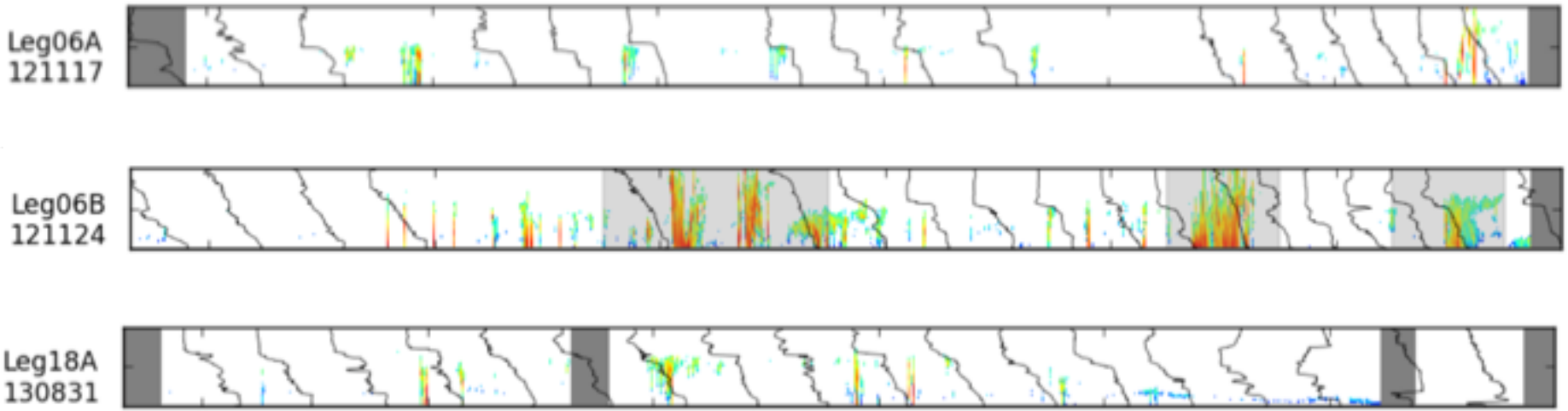


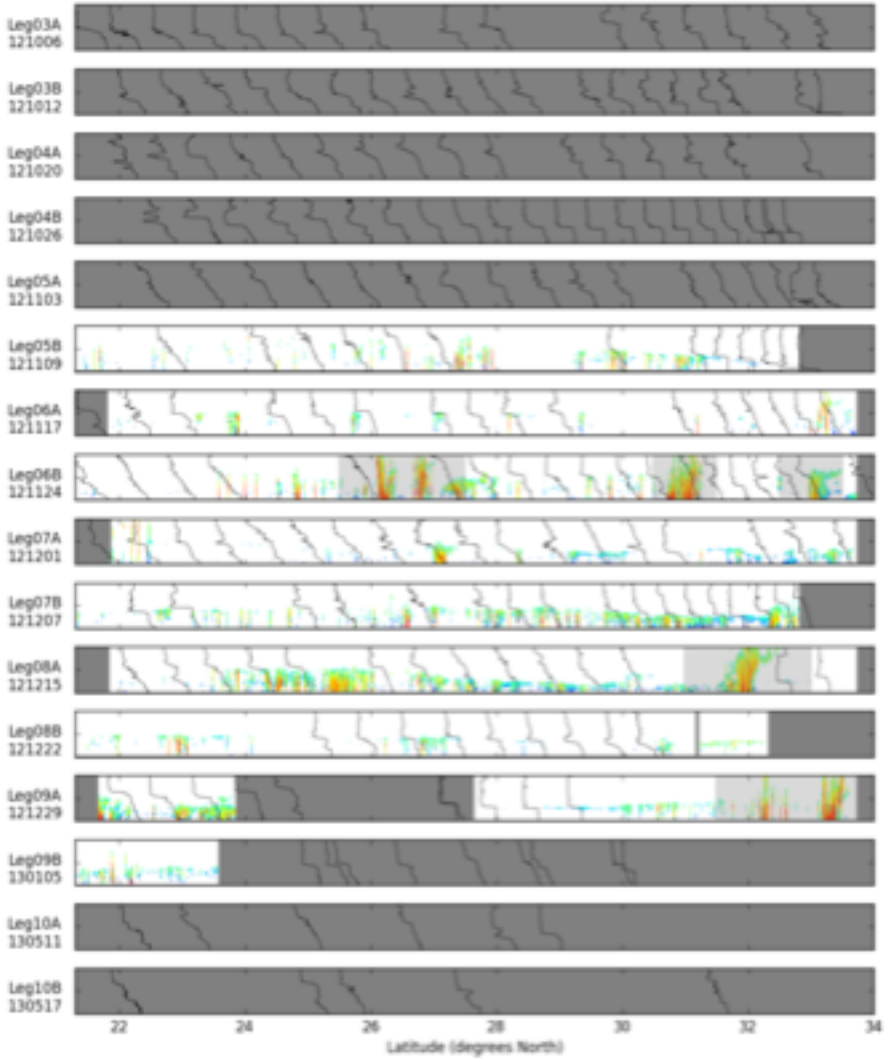

CAUTION
CAUTION

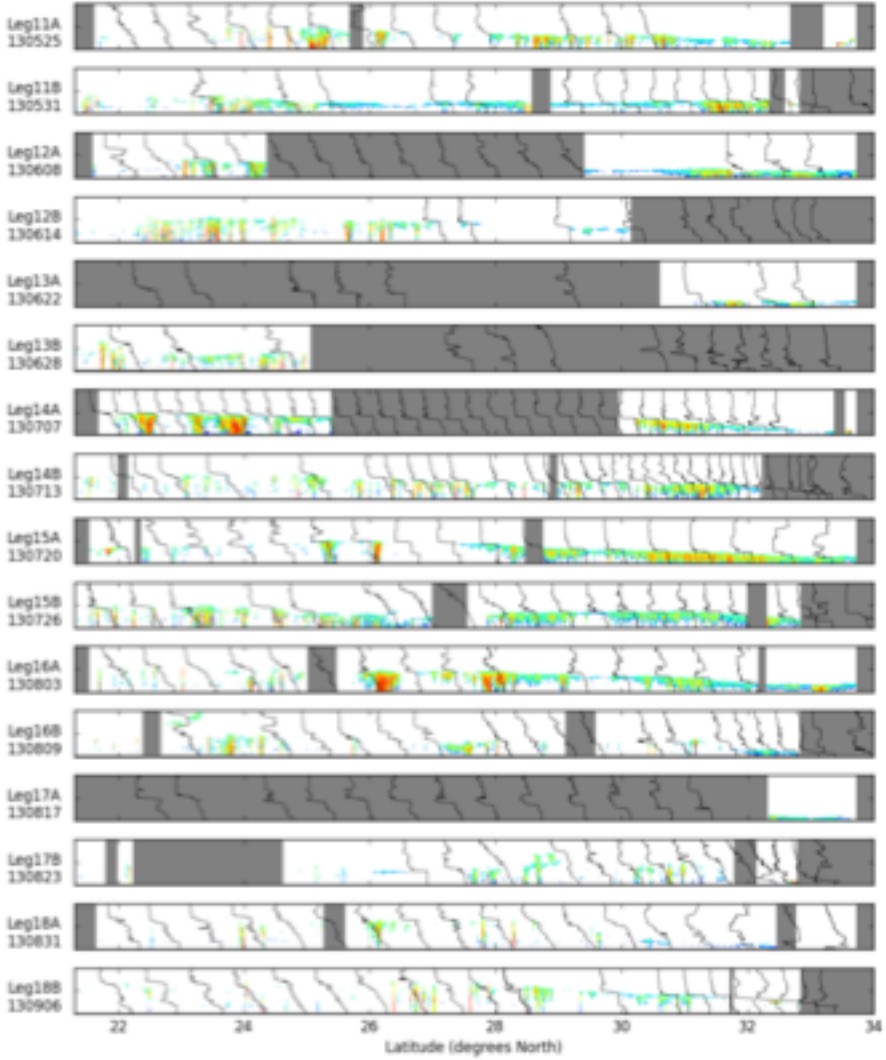
Legs with “textbook” boundary layer cloud transition



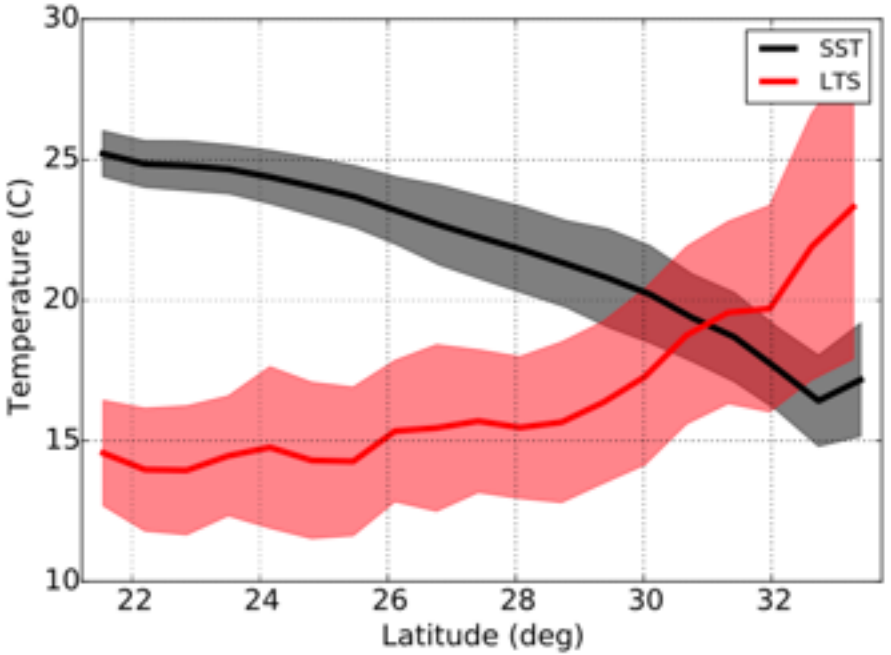
Not all legs follow the “textbook”

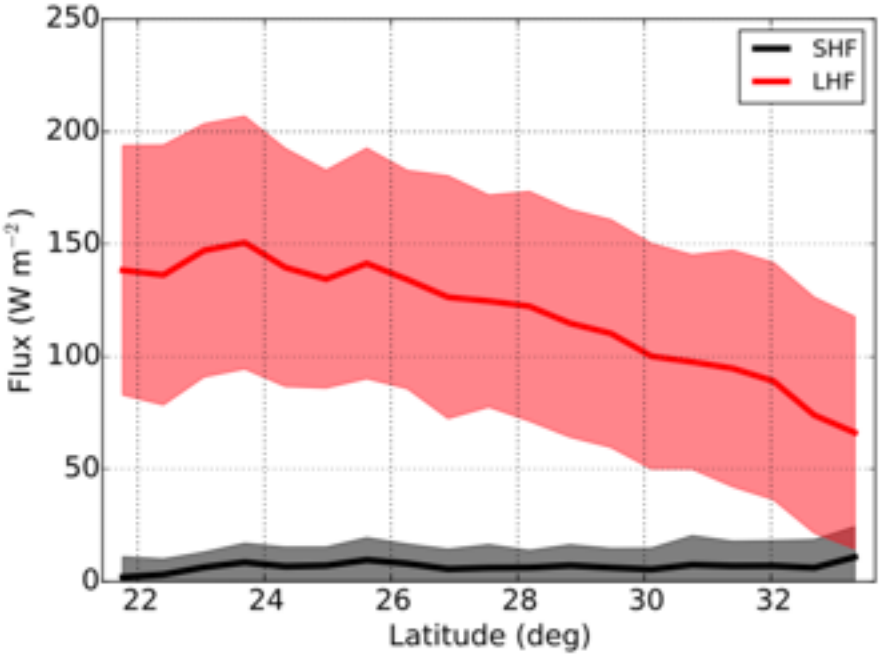



Leg03A
121006
Leg03B
121012
Leg04A
121020
Leg04B
121026
Leg05A
121103
Leg05B
121109
Leg06A
121117
Leg06B
121124
Leg07A
121201
Leg07B
121207
Leg08A
121215
Leg08B
121222
Leg09A
121229
Leg09B
130105
Leg10A
130511
Leg10B
130517
22
24
26
28
30
32
34
Latitude (degrees North)

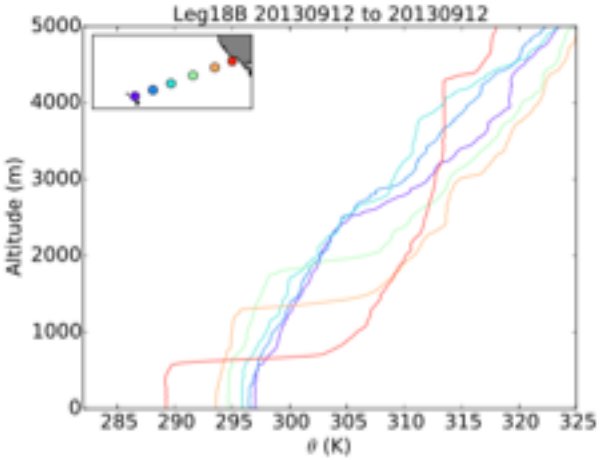

Leg11A
130525
Leg11B
130531
Leg12A
130608
Leg12B
130614
Leg13A
130622
Leg13B
130628
Leg14A
130707
Leg14B
130713
Leg15A
130720
Leg15B
130726
Leg16A
130803
Leg16B
130809
Leg17A
130817
Leg17B
130823
Leg18A
130831
Leg18B
130906
22
24
26
28
30
32
34
Latitude (degrees North)

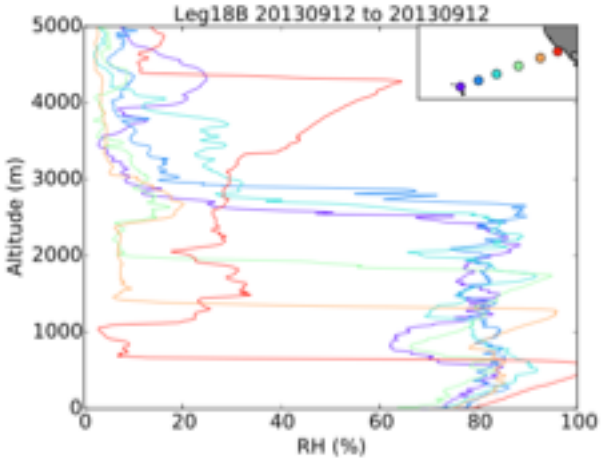
SST, LTS, and surface fluxes

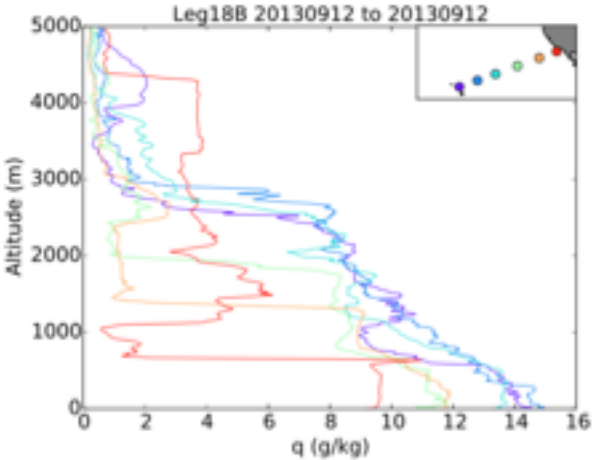




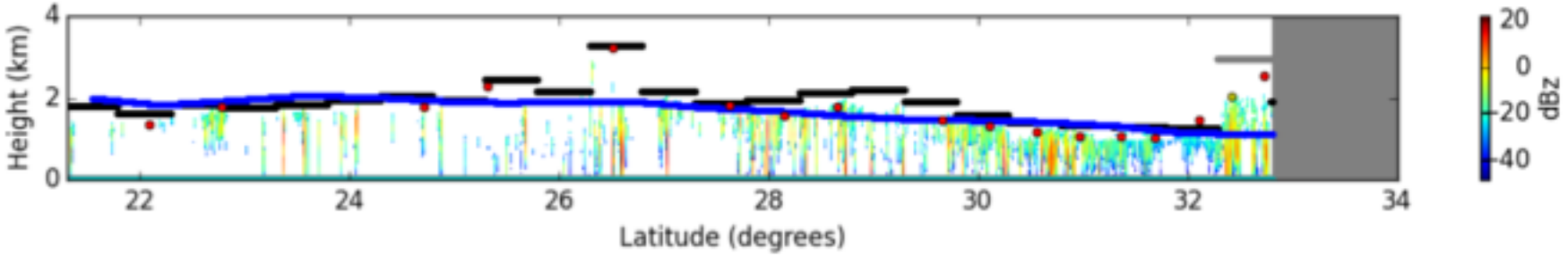
Sample thermodynamic profiles

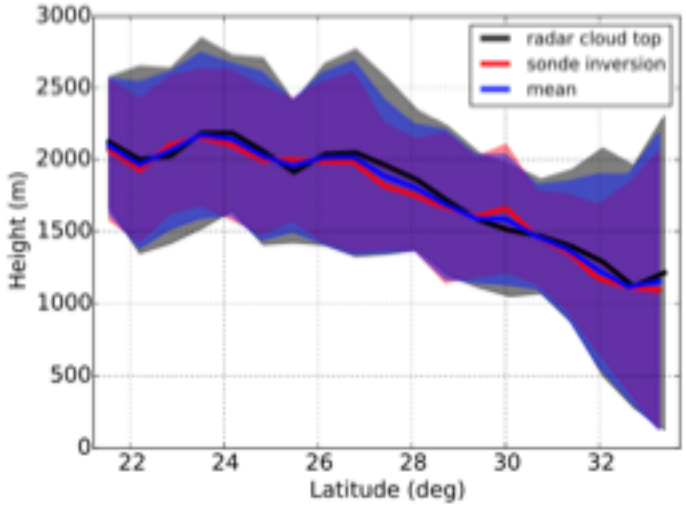




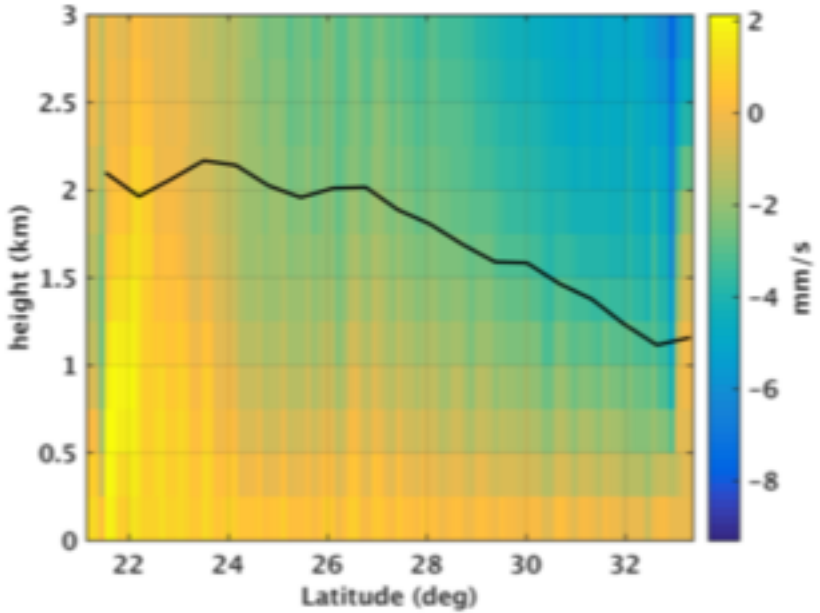


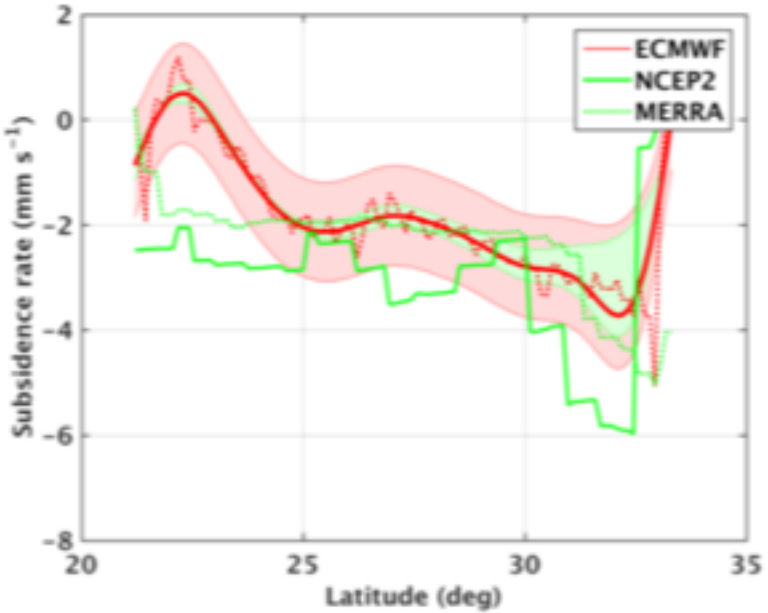
Boundary layer height



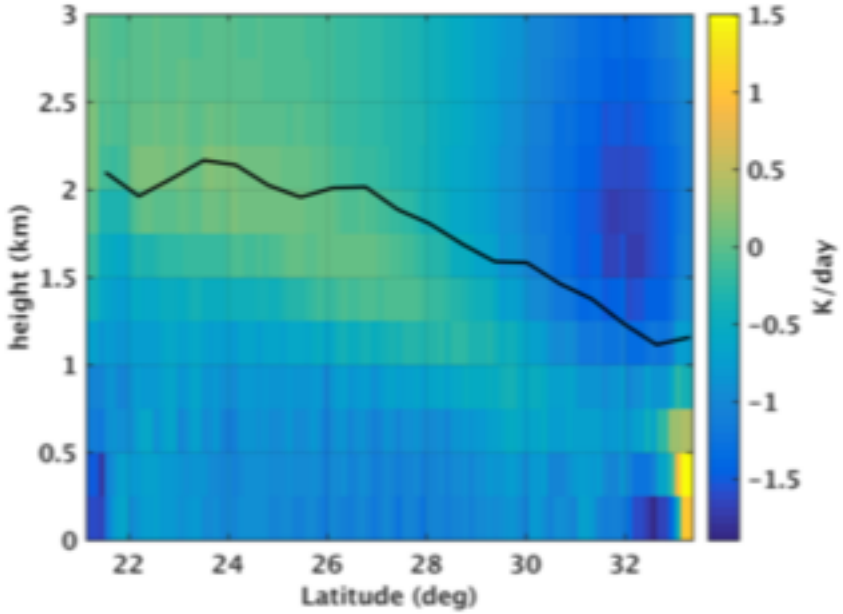


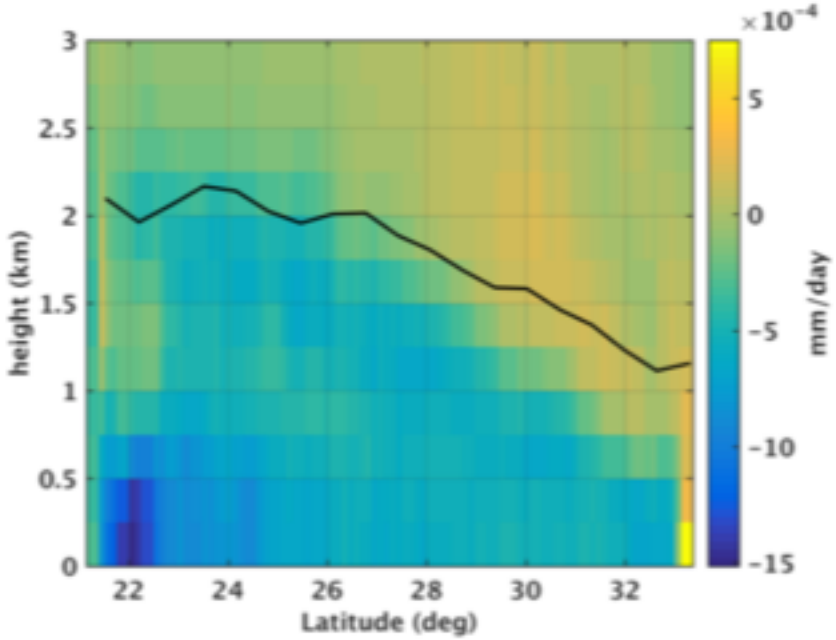
Subsidence (from ECMWF reanalysis)



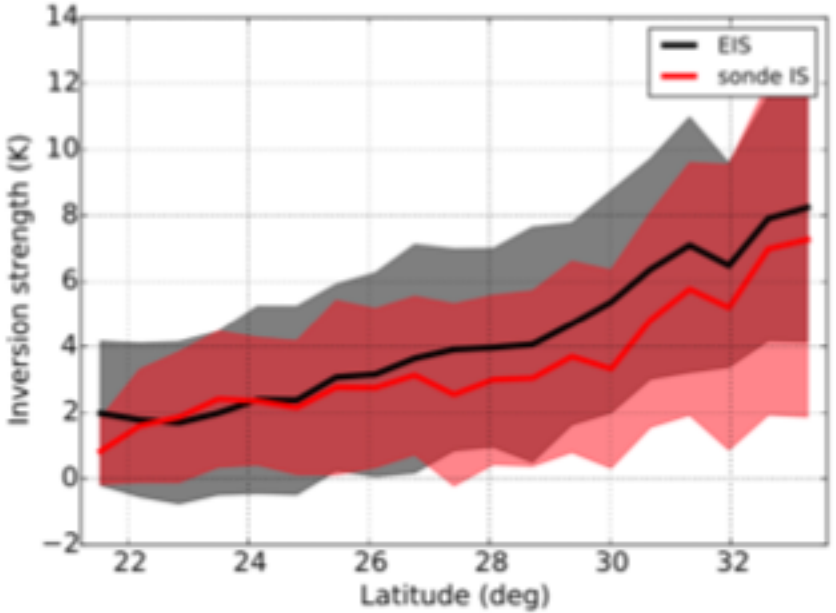


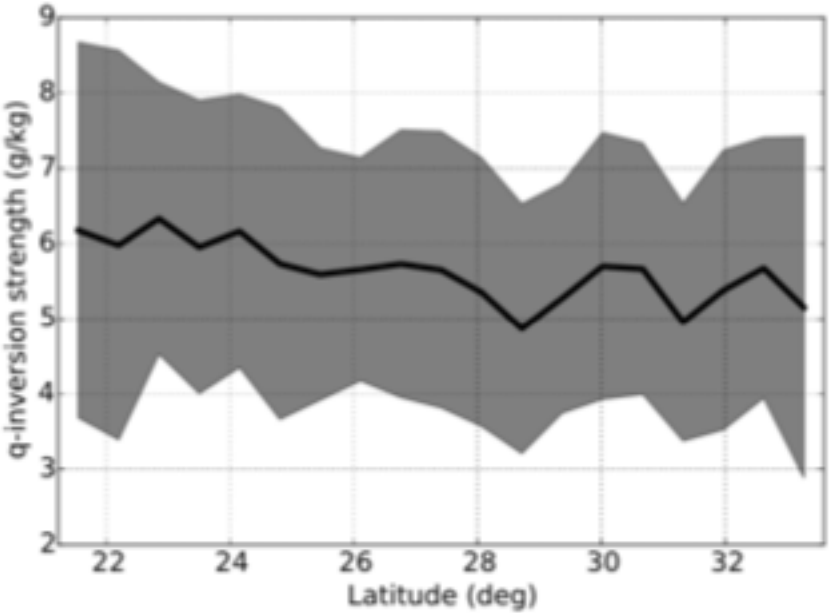
Advection (from ECMWF reanalysis)



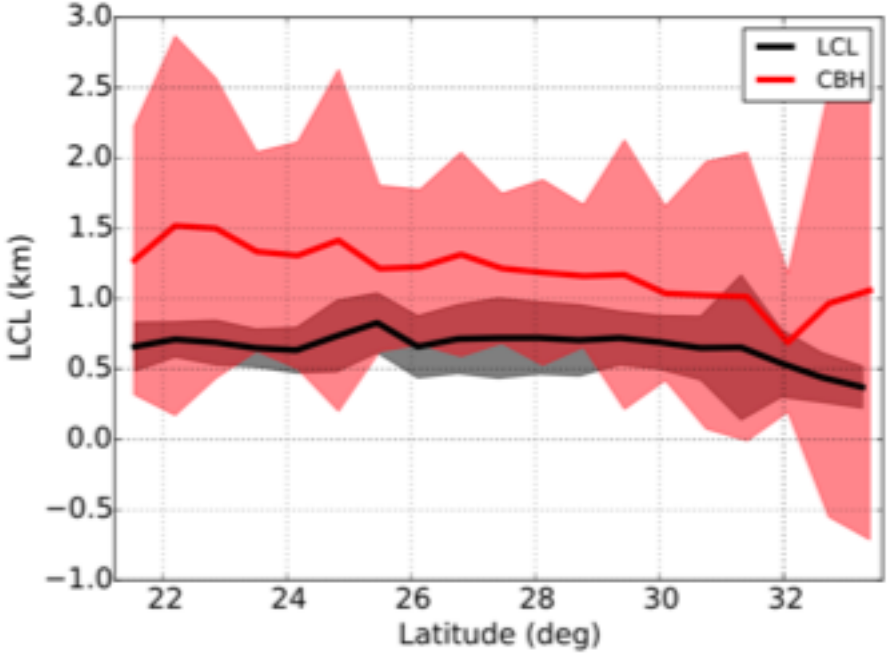


Inversion strength (from radiosondes)

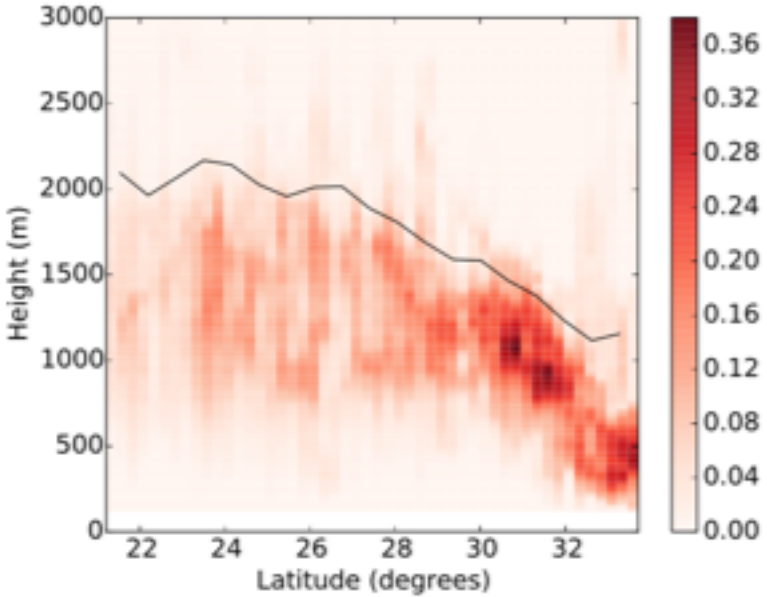


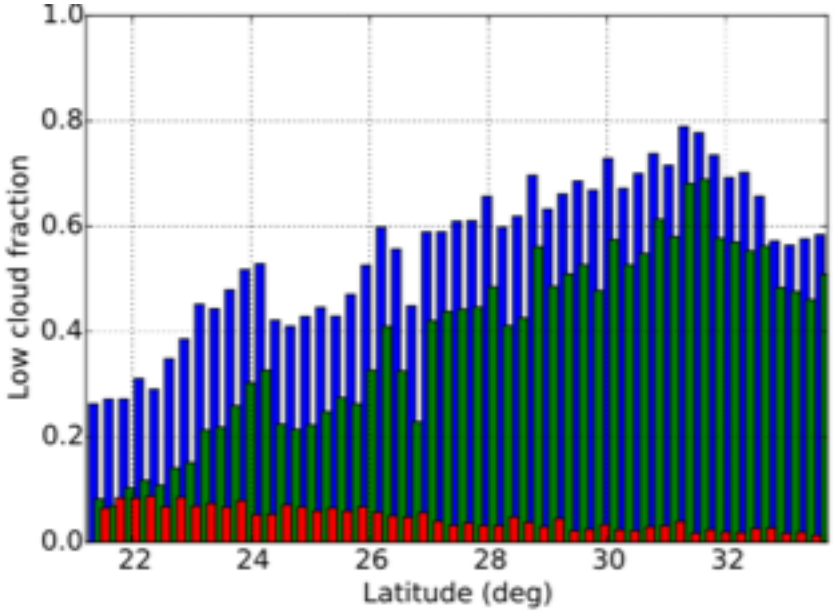


Lifting condensation level and cloud base height



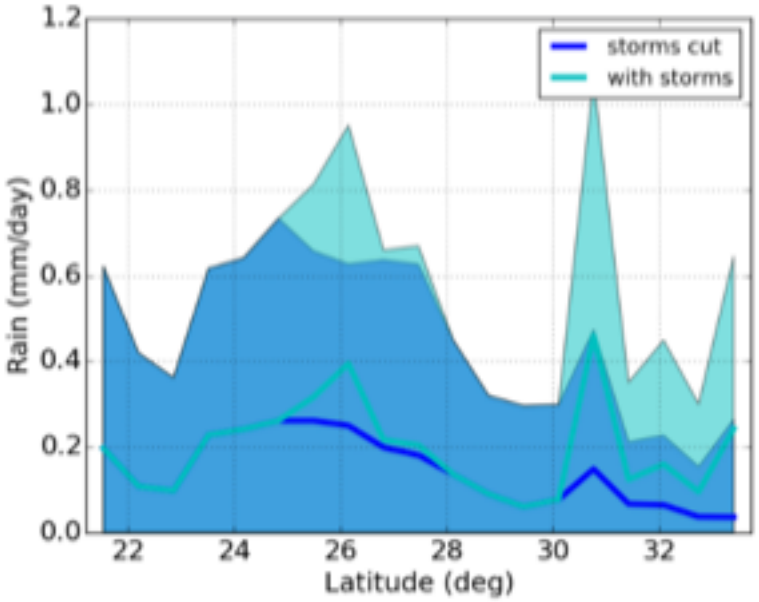
Cloud cover and cloud type

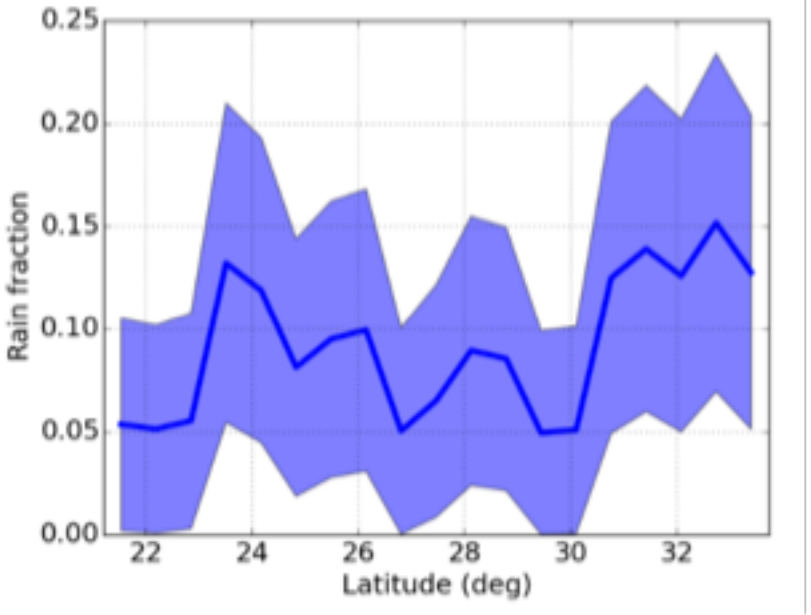




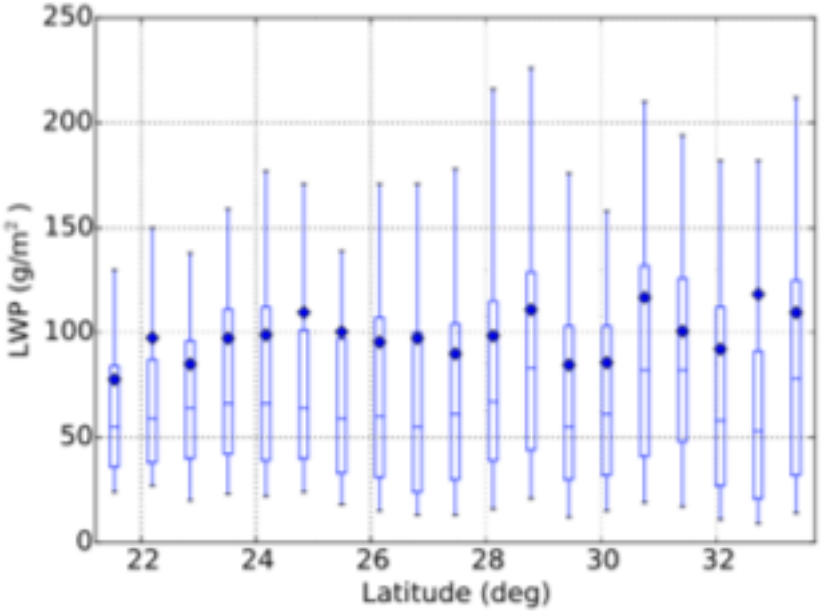
Blue: all low clouds; green: clouds designated as stratocumulus only; red: clouds designated as cumulus only.

Precipitation





Liquid water path



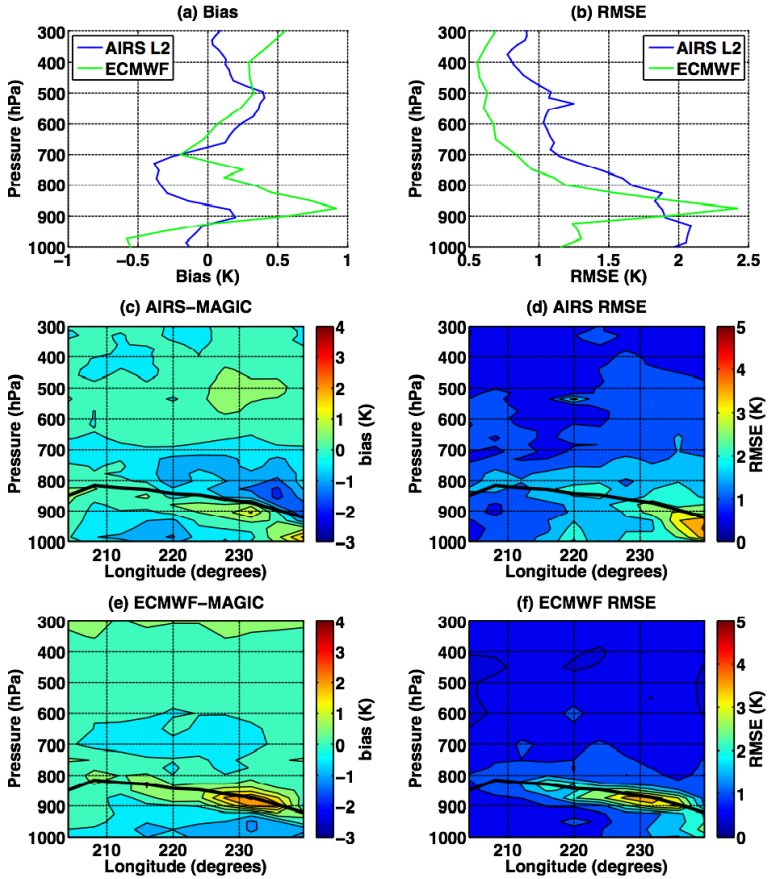
Seasonal and diurnal variation

Variable	Units	Campaign	NE	SW	Day	Night	Summer	Winter
BLH (refl)	m	1772	1463	2047	1759	1783	1552	1823
BLH (sonde)	m	1738	1422	1986	1735	1794	1570	1871
LTS	C	16.6	18.8	14.8	16.7	16.2	18.2	14.3
CF		0.55	0.67	0.45	0.55	0.56	0.63	0.59
sonde TIS	K	3.45	4.84	2.33	3.52	3.35	4.67	2.24
EIS	K	4.23	6.10	2.73	4.44	3.75	5.81	2.35
sonde qIS	g/kg	5.63	5.36	5.86	5.70	5.47	5.95	4.91
LCL	km	0.66	0.61	0.70	0.67	0.63	0.69	0.63
CBH	km	1.2	1.0	1.3	1.2	1.2	1.1	1.3
Rain, filtered	mm/hr	0.01	0.00	0.01	0.00	0.01	0.01	0.01
Rain, all	mm/hr	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Rain fraction		0.09	0.11	0.08	0.08	0.09	0.13	0.11
LWP	g/m^2	98	101	94	91	110	78	164

Validation of remote sensing

AIRS and ECMWF
temperature bias, RMSE

Kalmus et al. 2015

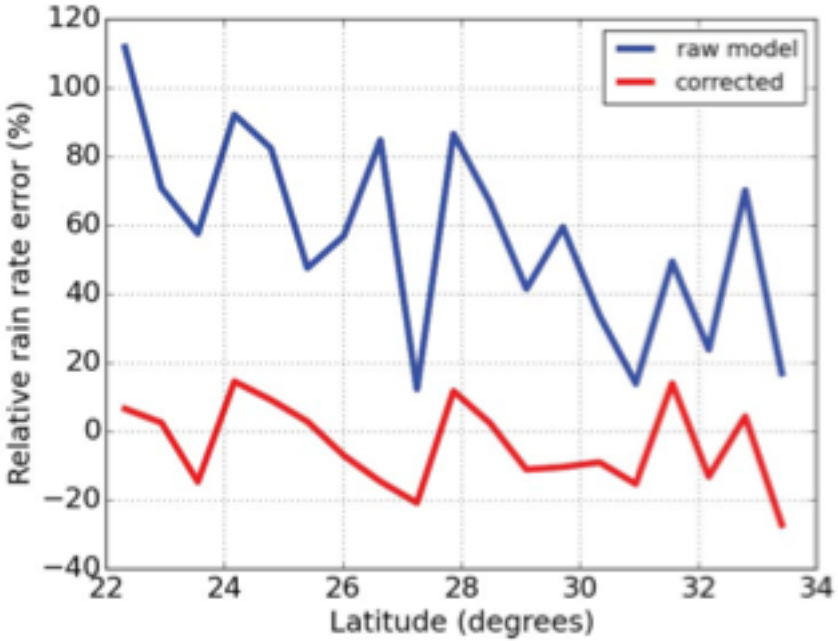


collocation:
±6 hours and 200 km
cuts out 83 sondes

QC 0 or 1
cut ECMWF too

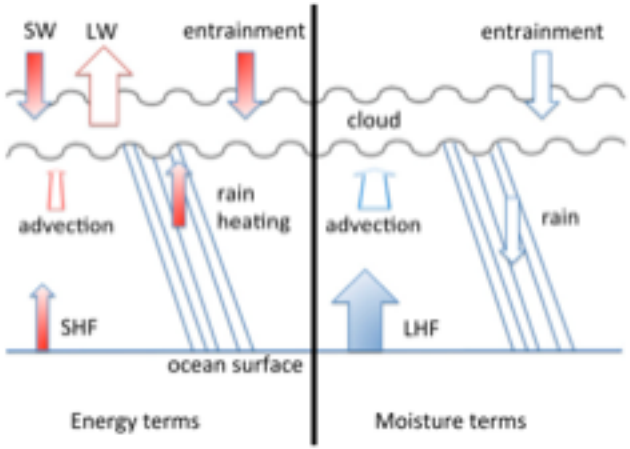
CloudSat marine warm rain bias correction

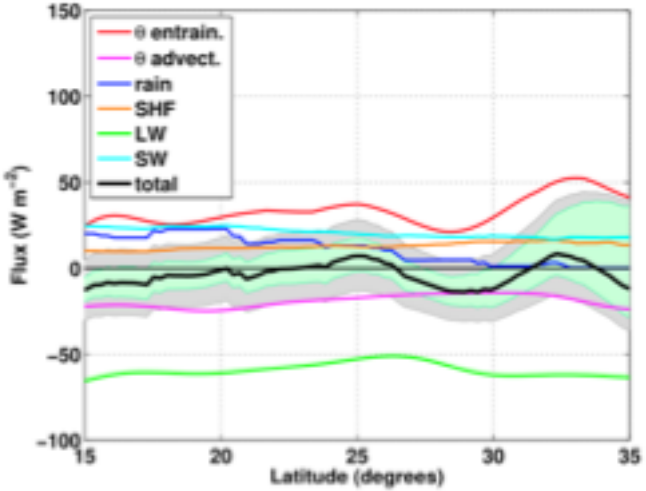
Kalmus & Lebsock (2017)

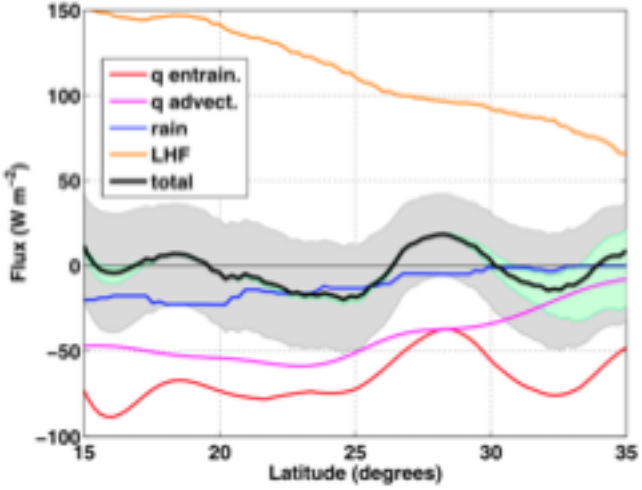


Boundary layer water and energy budgets

Kalmus, Lebsock, and Teixeira (2014)







Conclusion

The MAGIC campaign is an excellent data set for studying the marine subtropical stratocumulus and trade cumulus regime, and the transition between them.

Applications include: model comparison, process studies, remote sensing validation.